Amendments to the Drawings:

The attached two sheets of drawings include changes to Figs. 33 and 34. These sheets replace the original sheets including Figs. 33 and 34. In Figs. 33 and 34 the label "Prior Art" has been added.

Attachment: Two Replacement Sheets

REMARKS

After the foregoing amendment, claims 1-26, as amended, are pending in the application. Claims 1, 3, 4, 6, 7 and 13 have been amended to more particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Claims 11 and 12 have been canceled. Applicants submit that no new matter has been added to the application by the Amendment.

Objections to the Drawings

The Examiner objected to Figs. 33 and 34 because they are not labeled "Prior Art". Applicants have attached replacement pages for Figs. 33 and 34 which are labeled "Prior Art" for the Examiner's approval. Accordingly, Applicants request reconsideration and withdrawal of the objection to the drawings.

Objection to the Claims

The Examiner objected to claim 4 because the phrase "said voltage command value" lacks antecedent basis. The phrase "voltage command value" in claim 4 has been amended in response to the Examiner's objection. Claim 3 has been similarly amended. Accordingly, Applicants request reconsideration and withdrawal of the objection to claim 4.

Rejection - 35 U.S.C. § 102

The Examiner rejected claims 1, 2, 4 and 5 under 35 U.S.C. § 102 as being unpatentable over U.S. Patent No. 5,547,375 (Marc). Applicants respectfully traverse the rejection.

Marc is directed to a controller for driving a brushless permanent magnet motor. The controller comprises a converter which converts alternating current line voltage to direct current and a pulse width modulated inverter circuit which commutates a driving signal to the motor. The converter and the inverter are connected by a bus. The bus voltage and the bus current are sampled and used by a commutation controller to maintain the commutation produced by the inverter such that the rotor is in-phase with the stator windings.

Referring to Fig. 1, Marc employs three samples of each cycle of the bus current waveform, shown in Fig. 9, to produce an average bus current signal, I_{bus} avg, a signal

representative of the envelope of the bus current, $I_{bus}env$ and a signal representative of the bus voltage V_{bus} to control the commutation of the inverter. As shown in Figs. 9 and 16, the bus current waveform is a sawtooth-like waveform which varies in shape according to whether the commutation angle is aligned, leading or lagging with respect to the rotor. As described at col. 7, lines 9-48, the magnitudes if the three samples are combined to determine an error in the phase of the commutation.

The method of the present invention for controlling a brushless motor is completely different from the method described by Marc. As described at pages 20-27 and shown in Figs. 1 and 2 of the application, the motor current Iu, Iv and Iw, <u>flowing between the inverter and the motor</u> is detected. Id and Iq current values are calculated with equation 1 by a dq conversion section 6 from the detected motor current and compared with values of Id* and Iq* based on a rotation command, torque command etc. The errors between the commanded values and the detected values are applied to proportional integral controllers (PI) 7, 8 and the resultant voltages Vd and Vq are applied to a reverse dq section 10 which calculates by equation 2 the <u>sinusoidal voltage command values</u> Vu, Vv and Vw.

Values Vu', Vv' and Vw' are calculated by subtracting the smallest of Vu, Vv and Vw from Vu, Vv and Vw in the line-to-line modulation section 11. The largest value, Vmax of Vu', Vv' and Vw' is compared with the value of the input voltage to the inverter Vpn in the ratio generation section 14. Depending on whether Vpn is greater than or less than Vmax, the PWM output duty values Du, Dv and Dw are determined based on equations 3 and 4. In the case where the input voltage detection value Vpn is larger than Vmax, the output duty values of the U, V and W phases are based on Vpn. However, if the input voltage detection value is less than Vmax, the output duty values are based on Vmax. Consequently, if the input voltage falls below the voltage required to be applied to the motor, the phases of the voltages applied to the brushless motor are maintained (not changed).

Amended claim 1 recites:

> *A motor control apparatus comprising:*
>
> > *an inverter circuit which receives a fluctuating*
>
> *voltage, converts said voltage into a desired voltage and outputs*
> *said desired voltage to a brushless motor, and*
>
> > *a control section which receives the input voltage to*
>
> *said inverter circuit, a motor current flowing to said brushless*

> *motor and a command value indicating the value of a current*
>
> *required to flow to said inverter circuit <u>and generates sinusoidal</u>*
>
> *<u>voltage command values</u> for controlling said inverter circuit, said*
>
> *control section <u>maintaining the phase</u> of the voltage applied to said*
>
> *brushless motor when the value of the input voltage to said*
>
> *inverter circuit is smaller than the value of a voltage required to be*
>
> *applied to said brushless motor.*

In order to anticipate a claim under 35 U.S.C. § 102, the reference must teach every element of the claim. MPEP § 2131. "<u>The identical invention must be shown in as complete detail as is contained in the ... claim.</u>" *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) and MPEP § 2131.

Applicants submit that Marc does not teach or suggest all the limitations of amended claim 1 for the following reasons:

(1)   Marc teaches receiving a current input to the inverter whereas claim 1 recites receiving a current flowing to the brushless motor. The current input to the inverter could only be the same as the current flowing to the brushless motor if the inverter were 100% efficient. One of ordinary skill in the art would understand that it is not possible to have a 100% efficient inverter. Accordingly, the current being sensed by shunt H is <u>not the same</u> as the current flowing to the brushless motor.

(2)   Marc teaches sampling the current flowing to the inverter three times every 60 degrees and determining a correction value by calculating the difference in the magnitude of the samples. Amended claim 1 recites generating sinusoidal voltage command values based on d-axis and q-axis current values. Marc does not teach or suggest generating a sinusoidal voltage command value.

(3)   Amended claim 1 recites maintaining the phase of the voltage applied to the motor when the input voltage falls below a required value. Marc does not teach or suggest any circuit or operation that maintains the phase of the voltage applied to the motor constant when the input voltage falls below a required value.

Applicants submit that Marc does not anticipate amended claim 1. Accordingly, Applicants respectfully request reconsideration and withdrawal of the §102 rejection of claim 1.

Claim 4 recites "A motor control apparatus in accordance with claim 1, wherein said control section calculates a voltage command value by using a calculation equation having a noninteracting term." The voltage command values Vu, Vv and Vw are determined from equation 2 based upon the values of Vd and Vq. The values of Vd and Vq are based respectively on the error between Id* and Id and the error between Iq* and Iq. Importantly, the value of Vd is based on Id and is independent of Iq and the value of Vq is based on Iq and is independent of Id. Consequently, it can be said that the voltage command values are calculated by an equation having a non-interacting term. In contrast, by basing the control of the motor on the measurement of a single variable, i.e. the bus current, containing both in-phase and quadrature components of current, Marc is unable to use a calculation equation having a non-interacting term to calculate a command value.

Claim 5 recites "A motor control apparatus in accordance with claim 1, wherein said control section detects the voltage of said inverter circuit, estimates a voltage to be <u>applied to said inverter circuit at the next control cycle and controls said inverter circuit</u>." The Examiner states that Fig 3. shows Vout and col. 5, lines 7-10 disclose an algorithm and that each output <u>should</u> be applied to the controller in the next cycle. However, it is not specifically disclosed that the voltage Vout or the output of the algorithm is applied to the next cycle.

Further, it is respectfully submitted that since amended claim 1 has been shown to be allowable, claims 2, 4 and 5, dependent on amended claim 1 are allowable, at least by their dependency. Accordingly, for all the above reasons, Applicants respectfully request reconsideration and withdrawal of the § 102 rejection of claims 2, 4 and 5.

Rejection - 35 U.S.C. § 103

The Examiner rejected claims 6, 7 and 11-26 under 35 U.S.C. § 103 as being unpatentable over Marc. Applicants respectfully traverse the rejection.

The Examiner has rejected claims 6, 7 and 11-13, stating that the inherent parasitic small inductance or small capacitance would read on the limitations.

Applicants have canceled claims 11-12 and amended claims 6 and 7 with the limitations of claims 11 and 12 respectively. Applicant has further deleted the term "small" and added a lower limit of 10^{-10} farads to the capacitance of and 10^{-8} Henrys to the inductance recited in amended claims 6, 7 and 13.

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed Cir. 1993), MPEP § 2112 IV.   In relying upon the theory of inherency, the Examiner must provide a basis in fact/or technical reasoning to reasonably support the determination that the alleged characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy*, 17 USPQ2d 1461, 1464, (Bd. Pat App. and Inter. 1990), MPEP § 2112 IV.

In view of the fact that the Examiner has not provided a basis in fact or technical reasoning to support a finding that the parasitic capacitance of the inverter in Marc's invention is greater than 10^{-10} farads and that the parasitic inductance on the input side of Marc's inverter is greater than 10^{-8} Henrys, Applicants respectfully request reconsideration and withdrawal of the § 103 rejection of claims 6, 7 and 13.
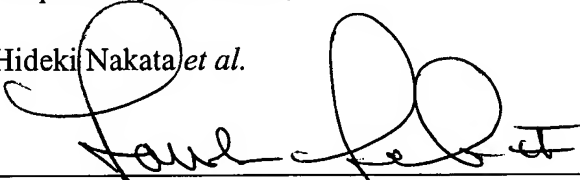
Further, it is respectfully submitted that since claim 1 has been shown to be allowable, claims 6, 7 and 13-26 dependent on claim 1 are allowable, at least by their dependency. Accordingly, for all the above reasons, Applicants respectfully request reconsideration and withdrawal of the § 103 rejection of claims 6, 7 and 13-26.

Conclusion

Insofar as the Examiner's objections and rejections have been fully addressed, the instant application, including claims 1-10 and 13-26, is in condition for allowance and Notice of Allowability of claims 1-10 and 13-26 is therefore earnestly solicited.

Respectfully submitted,

Hideki Nakata *et al.*

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(Date)

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attachment (two drawing sheets)